Influence of gender on cardiac risk and survival in patients with infrarenal aortic aneurysms

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Purpose: To determine whether gender distinctions influence the cardiac risk or survival rates associated with surgical treatment of infrarenal abdominal aortic aneurysms (AAAs).
Methods: From 1983 to 1988, graft replacement of intact AAAs was performed in 490 men (84%) and in 92 women (16%) who had no history of myocardial revascularization before the discovery of their AAAs. Patients of both genders were comparable with respect to mean age (68 years) and the prevalence of coronary artery disease (CAD) by standard clinical criteria (men, 73%; women, 65%). Preoperative coronary angiography was obtained in 471 of the 582 patients (men, 81%; women, 80%) during this particular study period. Preliminary coronary bypass was warranted on the basis of existing indications in 111 (24%) of these 471 patients (men, 25%; women, 18%), including 104 (31%) of the 337 who had clinical indications of CAD (men, 32%; women, 26%) but only 7 (5.2%) of the 134 who did not (men, 6%; women, 4%). Follow-up data were collected during a mean interval of 53 months (men, 54 months; women, 48 months) and were analyzed by Kaplan-Meier survival analysis and Cox proportional hazards models.
Results: Twenty-nine perioperative deaths (5.0%) occurred in conjunction with AAA repair (men, 5.1%; women, 4.3%), and 126 early and late deaths have occurred (men, 22%; women, 22%). Survival rates for the series were found to correlate with age ($p < 0.001$), the serum creatinine level ($p < 0.001$), and the coronary angiographic classification ($p < 0.001$). No significant differences were identified between the gender cohorts. The cardiac mortality rate for AAA resection was only 1.8% in the 111 patients who had preliminary coronary bypass, but five additional perioperative deaths (4.5%) related to renal failure or sepsis occurred in this group. However, 5-year survival rates for patients receiving preliminary bypass (men, 82%; women, 75%) were closely comparable with those for patients found to have only mild to moderate CAD by angiography (men, 86%; women, 82%).
Conclusion: We conclude that men and women with AAAs have similar cardiac risks and survival rates associated with surgical treatment. Our results also illustrate that the potential benefit of coronary intervention for severe CAD in patients of either gender must be considered in the context of long-term outcome and the early mortality rate of AAA repair. (J Vasc Surg 1996;23:870-80.)

Women represent a distinct minority of patients having infrarenal abdominal aortic aneurysms (AAAs). With the exception of certain familial probands in which gender is more equally distributed,[1-2] the ratio of women to men with AAAs has been calculated to be only 1:3 in population studies and is even more discordant (1:5) among patients receiving elective surgical treatment.[3-6] Closer parity with respect to gender is usually found only in the presence of advanced age (75 to 90 years) and/or AAA rupture.[7-10] Both of these observations suggest that the relative infrequency with which AAAs occur in women might contribute to a delay in their diagnosis. Although it has generally been assumed that AAAs may be electively repaired as safely and with the same favorable effect on late survival in women as in men, surprisingly little specific information is available in this regard.

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During a recent survey documenting the early results of surgical treatment for 8,185 intact AAAs over a period of 11 years (1980 to 1990) in Michigan, Katz et al.[11] discovered that the operative mortality rate in women (11%) was significantly higher ($p < 0.001$) than in men (6.8%). Crawford et al.[12] also reported an early mortality rate that was slightly higher for women (5.7%) than for men (4.6%) in a series of 920 patients with intact infrarenal AAAs collected by the senior author from 1955 to 1980. Late survival rates were virtually identical irrespective of gender throughout 15 years of follow-up, however, and were primarily influenced by age and coronary artery disease (CAD). Perhaps the most comprehensive data concerning gender distinctions related to the repair of intact AAAs have been generated from a prospective study of nearly 700 patients that has been conducted since 1986 by the Canadian Society for Vascular Surgery.[13-15] Johnston et al.[15] have now concluded that age, clinical evidence of CAD, and the serum creatinine value rather than gender are the principal discriminants of both early and late surgical outcome in this cohort.

The importance of CAD and additional cofactors such as age and gender in predicting perioperative risk and long-term survival for patients who require AAA repair has been of interest to us since we and others completed our initial investigation of preoperative coronary angiography in 1982.[16-19] In this study, we have analyzed our subsequent experience from 1983 to 1988 to explore the relations of gender to surgical outcome.

MATERIAL AND METHODS

During the six years of the study period 734 patients underwent infrarenal AAA repair at our center without complementary renal or visceral revascularization. Forty of these patients were omitted from this report because they had ruptured AAAs, and another 112 were excluded because they had a remote history of coronary artery bypass grafting (CABG) before the discovery of their AAAs. Thus this study is composed of 582 patients—490 men (84%) and 92 women (16%). All AAAs were replaced with straight or bifurcated woven fabric grafts under general or epidural anesthesia with standard techniques that have been described elsewhere.[20] Each hospital chart was retrospectively abstracted to gather perioperative information for a computer profile, and data concerning late survival were obtained on the basis of outpatient records and an ongoing telephone canvass of patients, their surviving family membes, and referring physicians. The maximum follow-up interval was 131 months, with a mean of 53 months (men, 54 months; women 48 months). Forty-eight patients (men, 8%; women, 11%) were lost to follow-up and were censored from further outcome analysis at the time of their last reported contact.

Table I contains a summary of selected clinical features for the series. The mean age at the time of operation was 68 years for patients of both genders, although more women were older than age 70 years (men, 40%; women, 48%). A majority of patients (men, 62%; women, 75%) were either hypertensive ($\geq$180/90 mm Hg) or required antihypertensive medication, but few (14%) were diabetic. Diabetes appeared to be more prevalent in men (15%) than in women (8%), but this feature had only marginal statistical significance ($p = 0.053$, χ^2 analysis). The mean serum creatinine value was 1.3 mg/dl for all patients; levels exceeding 1.5 mg/dl were present in 20% of the men and in 18% of the women, but only three patients were maintained on dialysis preoperatively.

Fig. 1 illustrates the clinical cardiac status for all 582 patients. Four hundred eighteen patients (men, 73%; women, 65%) had one or more indications of CAD on the basis of either a history of myocardial infarction (MI) or angina pectoris or abnormal findings (Q waves, ischemic ST-T changes) on a 12-lead electrocardiogram (ECG). CAD was clinically evident in 64% of the patients younger than age 60 (men, 67%; women, 50%), in 66% of those aged 60 to 70 (men, 66%; women, 64%), and in 81% of those older than age 70 (men, 83%; women, 70%). Data were also collected regarding the five cardiac risk factors (prior MI, angina, congestive heart failure, age >70 years, diabetes) that Eagle et al.[21] previously correlated with the perioperative complication rates of elective vascular surgery. Thirty percent of our 582 patients had none of these factors (men, 30%; women, 34%), whereas 59% of the patients had one or two factors (men, 59%; women, 62%), and 10% of the patients had three or more (men, 11%; women, 4%).

Preoperative coronary angiography. We obtained preoperative coronary angiography before AAA repair on a regular basis throughout the 5 years (1978 to 1982) immediately preceding this study because angiography then was the only diagnostic alternative to traditional stress ECG testing for detecting severe CAD.[16] According to the prevailing indications for myocardial revascularization at that time, 81 (31%) of the 263 patients with AAAs in our earlier study were considered to be candidates for CABG as a preliminary procedure. The introduction of thallium$_{201}$ imaging in the mid-1980s represented

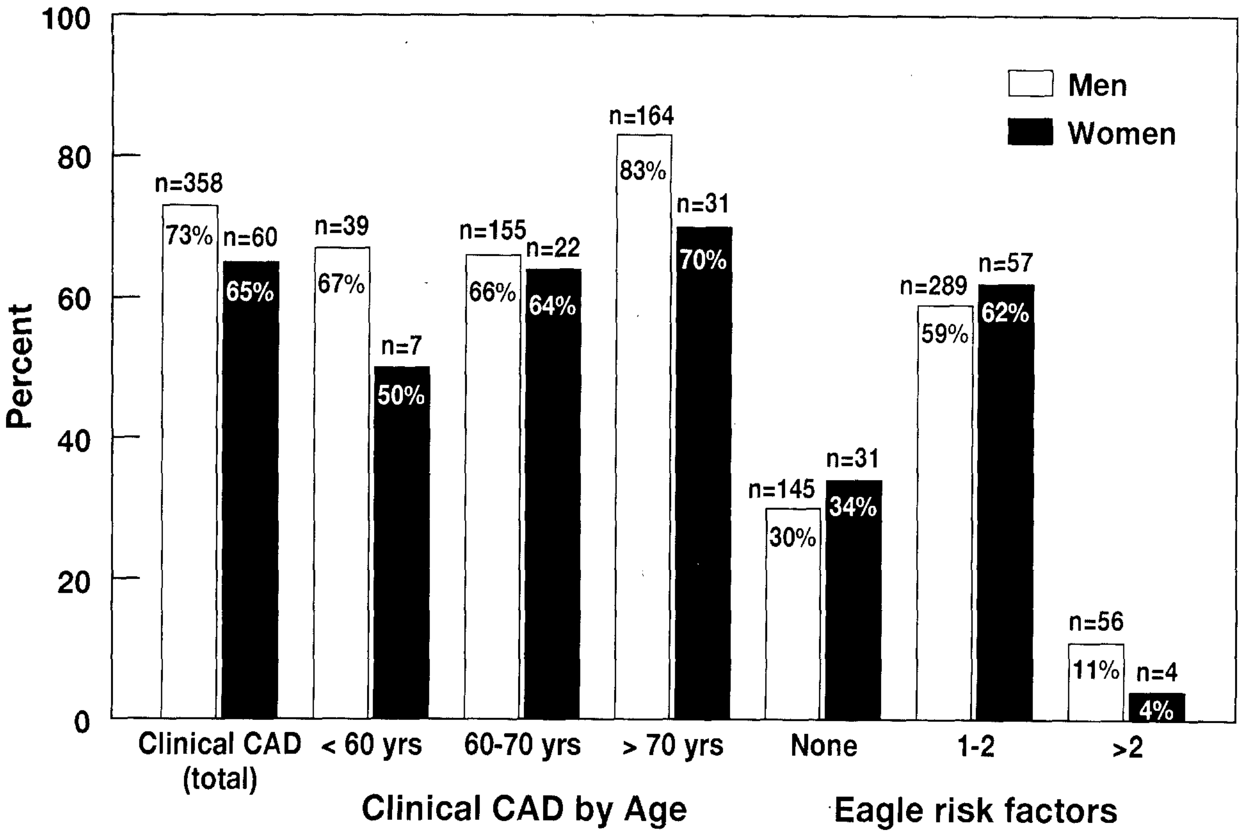

Fig. 1. Data related to clinical cardiac risk for all 582 patients according to gender.

an improvement in noninvasive cardiac screening, but during the initial phases of its development we continued to depend heavily on coronary angiography because of the apparent prevalence of severe CAD in the patient population at our center.

In summary, only 32 (5.4%) of the 582 patients in this series had noninvasive cardiac testing, and 471 patients (81%) underwent preoperative coronary angiography. Table II presents the angiographic classification of CAD in these 471 patients. One hundred eleven patients (24%) had correctable CAD that met existing criteria for CABG during this series, and an additional 44 patients (9.3%) also had severe CAD that was either inoperable (n = 15, 3.2%) or was instead treated by percutaneous transluminal coronary angioplasty (PTCA) (n = 29, 6.2%). Severe CAD was discovered in 139 (35%) of the 397 men for whom coronary angiography was performed compared with 16 (22%) of the 74 women. Fig. 2 shows a correlation between the angiographic classification of CAD and the clinical cardiac status. Irrespective of gender, the documented incidence of severe CAD justifying CABG was significantly higher ($p < 0.001$) in patients who had clinical evidence of CAD (104 of 337, 31%) than in those who did not (7 of 134, 5.2%). Men appeared less likely to have normal coronary arteries or only mild to moderate CAD in the absence of clinical markers (men, 47%; women, 70%) but no other gender differences could be identified.

By definition, all 111 patients classified as having severe correctable CAD survived preliminary CABG and subsequently had elective operations for graft replacement of their AAAs. The AAA procedures were performed at a mean interval of 1.7 months after CABG, ranging from the same hospital admission to 9 months later. Our database does not include the records of other patients who may have had fatal complications in conjunction with preliminary CABG before their AAAs could be repaired, but the operative mortality rate for CABG in this setting has been approximately 5% in the past.[16]

Statistical methods. Freedom from death (including perioperative death) and late cardiac event–free survival were the primary outcomes of interest. For each outcome, Kaplan-Meier survival curves were calculated overall and within genders. Log-rank tests were used to compare survival rates among categories of the independent variables consisting of gender, age (>70 years), the serum creatinine group, clinical indications of CAD, the number of Eagle risk factors,

Table I. Selected clinical features for 582 patients

	Men		*Women*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Patients	490	84	92	16	582	100
Age						
Range	48-94		29-87		29-94	
Mean	68		68		68	
<60 Yrs	58	12	14	15	72	12
60-70 Yrs	235	48	34	37	269	46
>70 Yrs	197	40	44	48	241	42
Hypertension	304	62	69	75	373	64
Diabetes	72	15	7	8	79	14
Serum creatinine (mg/dl)						
Range	0.5-8.2		0.5-9.4		0.5-9.4	
Mean	1.3		1.3		1.3	
<1.5	390	80	75	82	465	80
1.5-2.5	82	17	11	12	93	16
>2.5	18	3	6	6	24	4

Table II. Results of preoperative coronary angiography in 471 patients

	Men (n = 397)		*Women (n = 74)*		*Total (n = 471)*	
	No.	*%*	*No.*	*%*	*No.*	*%*
≥60% Stenosis	274	69	45	61	319	68
1 Vessel	32	8	4	5	36	8
2 Vessels	66	17	11	15	77	16
3 Vessels	176	44	30	41	206	44
Normal or mild to moderate CAD	116	29	30	40	146	31
Advanced but compensated CAD	142	36	28	38	170	36
Severe correctable CAD with CABG	98	25	13	18	111	24
Severe unoperated CAD						
With PTCA	28	7	1	1	29	6
Inoperable	13	3	2	2	15	3

and the coronary angiographic classification. These comparisons (except for gender) were done overall and within gender. The power of our statistical analysis to detect an absolute difference in survival rates of 10% between genders was 0.8 at the 0.05 significance level.

For each outcome, a Cox proportional hazards model was fit using stepwise regression to choose the combination of independent variables that, when taken together, best explain survival. Age and serum creatinine were considered as categorical and continuous variables. The significance criterion for each variable to enter and to remain in the model was 0.05. Three-year and 5-year survival estimates were then calculated for specific covariate patterns of the variables in each final model.

RESULTS

Perioperative complications. The operative mortality rate for AAA repair was 5.0% (men, 5.1%; women, 4.3%). Fourteen of the 29 in-hospital deaths (2.4%) were caused by cardiac events (men, 2.7%; women, 1.1%), 10 of which (men, 1.8%; women, 1.1%) were primarily related to refractory arrhythmias. All nine perioperative MIs that were confirmed by selective isoenzyme studies occurred in men (1.8%), and four of these (0.8%) were fatal. There were seven perioperative deaths (6.3%) among the 111 patients who had preliminary CABG. Five of these (4.5%) were attributed to sepsis or renal failure; three patients developed postoperative pneumonia, one had fungal septicemia, and another died with renal failure after repair of a large (7 cm) AAA despite a baseline creatinine level of 6 mg/dl. Only two of the seven deaths (1.8%) were caused by cardiac arrhythmias, and no early MIs were documented in the group of patients who received preliminary CABG.

Survival rates. One hundred twenty-six early and late deaths occurred in this series (men, 22%; women, 22%), 102 of which occurred later than 30 days postoperatively (men, 18%; women, 17%). Table III contains data correlating certain independent vari-

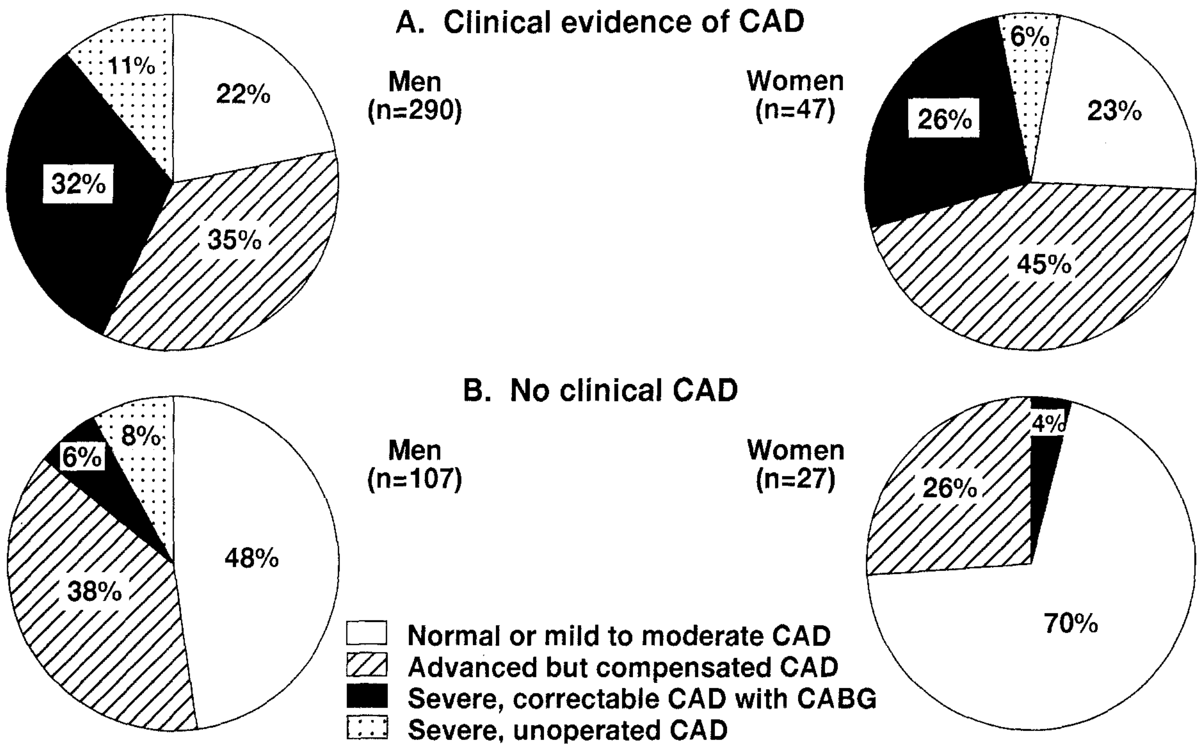

Fig. 2. Coronary angiographic classification in 471 patients according to gender and clinical cardiac status.

ables with Kaplan-Meier 5-year survival rates (±SEM) together with statistical comparisons that have been calculated on the basis of a maximum follow-up interval of 131 months for all 582 patients. The aggregate 5-year survival rate was 77% ± 2%. (In comparison, the actuarial 5-year survival rates for men and women at the age of 68 years in the general population are 83% and 90%, respectively.[22]) By univariate analysis, survival was related to age, the serum creatinine value, clinical indications of CAD, the number of Eagle risk factors, and the composite influence of the coronary angiographic findings and the preliminary management of severe CAD. Each of these features attained significance in men, as did age and creatinine in the smaller cohort of women. Although the importance of cardiac-related variables (clinical CAD, Eagle risk factors, coronary angiographic classification) could not clearly be demonstrated in women, there was no statistical difference in survival between the gender cohorts.

Cox proportional hazards models were fit on the entire series to obtain aggregate models explaining survival (Table IV). All variables considered univariately were potential candidates for the models. In the first of these models, age and creatinine values were considered as categorical variables; significantly higher mortality rates were associated with age >70 years and with serum creatinine ≥1.5 mg/dl. In the second model, age and creatinine were considered as continuous variables; significant escalation in the mortality rate was identified for each decile increment of age and for each increment of 1 mg/dl in serum creatinine. The coronary angiographic classification was the only other independent variable that was found to have a significant influence on mortality rates according to both of the proportional hazards models. Patients who survived preliminary CABG for severe correctable CAD had a risk for subsequent death that was nearly identical to that for the reference group of patients who had either normal coronary arteries or only mild to moderate CAD (risk ratio, 1.0). The highest mortality risk occurred in patients who had severe inoperable CAD, and intermediate risks that generally approximated the risk of advanced but compensated CAD were calculated for patients who underwent preliminary PTCA as well as for those in whom preoperative coronary angiography was not performed.

By using the proportional hazards model for categorical age and creatinine (model 1), composite survival rates were estimated to determine the collective importance of all three major mortality risks

Table III. Kaplan-Meier 5-year survival rates (±SEM) in the presence of selected independent variables

	Men (%)	*Women (%)*	*Total (%)*
All patients	77 ± 2	77 ± 5	77 ± 2
Age			
≤70 Yrs	84 ± 2	86 ± 5	85 ± 2
>70 Yrs	67 ± 4	64 ± 8	66 ± 3
	$p < 0.001$	$p = 0.028$	$p < 0.001$
Serum creatinine (mg/dl)			
<1.5	80 ± 2	81 ± 5	80 ± 2
1.5-2.5	72 ± 5	60 ± 16	71 ± 5
>2.5	52 ± 13	40 ± 20	49 ± 11
	$p = 0.01$	$p = 0.017$	$p < 0.001$
Clinical CAD			
Yes	74 ± 3	77 ± 6	75 ± 2
No	85 ± 3	75 ± 9	83 ± 3
	$p = 0.012$	$p = 0.82$	$p = 0.030$
Eagle risk factors			
None	87 ± 3	79 ± 8	86 ± 3
1-2	73 ± 3	77 ± 6	74 ± 3
>2	72 ± 6	DNS	71 ± 6
	$p = 0.002$	$p = 0.31$	$p = 0.004$
Angiographic classification			
Normal or mild to moderate CAD	86 ± 5	82 ± 7	84 ± 3
Advanced but compensated CAD	75 ± 4	74 ± 10	75 ± 4
Severe correctable CAD with CABG	82 ± 4	75 ± 13	81 ± 4
Severe unoperated CAD			
With PTCA	77 ± 8	DNS	78 ± 8
Inoperable	26 ± 13	DNS	30 ± 12
Patients without angiograms	74 ± 5	73 ± 12	74 ± 5
	$p < 0.001$	$p = 0.87$	$p < 0.001$

p Values: comparison of categories during complete period of observation (maximum, 131 months).
DNS: Data not sufficient for analysis.

Table IV, A. Cox proportional hazards models estimating odds of mortality at any given time point for significant variables

Independent variables	*Risk ratio*	*95% Confidence interval*	*p Value*
Model 1: Categorical age and creatinine			
Age			<0.001
≤70 Yrs (reference)	1.0	NA	
>70 Yrs	2.70	(1.85,3.9)	
Creatinine			<0.001
<1.5 mg/dl (reference)	1.0	NA	
1.5-2.5 mg/dl	1.30	(0.84,2.0)	
>2.5 mg/dl	3.92	(2.0,7.7)	
Angiographic classification			0.004
Normal or mild to moderate CAD (reference)	1.0	NA	
Advanced but compensated CAD	1.56	(0.92,2.6)	
Severe correctable CAD with CABG	0.98	(0.53,1.8)	
Severe unoperated CAD			
With PTCA	1.39	(0.56,3.4)	
Inoperable	4.81	(2.25,10.3)	
Patients without angiograms	1.64	(0.92,2.9)	

NA, Not applicable.

(Table V). Advanced age (>70 years) and extreme elevations in creatinine (>2.5 mg/dl) appear to be associated with the most serious reductions in 3-year and 5-year survival rates. With the exception of patients having inoperable CAD, however, survival rates for the other groups in our angiographic classification were similar within comparable ranges of age and creatinine. These data further suggest that survival rates for patients who underwent successful CABG for severe CAD are equivalent to those in patients having only modest CAD at any stratification of age and creatinine. The results of PTCA also seem

Table IV, B. Cox proportional hazards models estimating odds of mortality at any given time point for significant variables

Independent variables	*Risk ratio*	*95% Confidence interval*	*p Value*
Model 2: Continuous age and creatinine			
Age (10-yr increments)	1.97	(1.55,2.5)	<0.001
Creatinine (increment of 1 mg/dl)	1.47	(1.22,1.8)	<0.001
Angiographic classification			
Normal or mild to moderate CAD (reference)	1.0	NA	0.012
Advanced but compensated CAD	1.51	(0.89,2.5)	
Severe CAD with CABG	0.93	(0.51,1.7)	
Severe unoperated CAD			
With PTCA	1.24	(0.50,3.1)	
Inoperable	4.16	(1.9,9.0)	
Patients without angiograms	1.47	(0.82,2.6)	

NA, Not applicable.

to be favorable in this respect, but it is reasonable to assume that candidates for PTCA had less extensive CAD than those in the CABG cohort.

The database for this report did not include patients who might have had fatal complications after preliminary CABG before their AAA repair. To account for the historic mortality rate (5%) of CABG in such patients at our center, we also computed the data in Tables III and IV with the addition of six proxy deaths during the perioperative period in the CABG cohort (new n = 117). Gender did not lend itself as a discriminant in this exercise, but the six proxy patients were assigned the same mean age (68 years) and creatinine value (1.2 mg/dl) as the original 582 patients in the series. By this approach, the 5-year survival rate in patients receiving CABG declined from 81% ± 4% to 77% ± 4%, and their mortality risk ratios increased from 0.98 to 1.32 (model 1) and from 0.93 to 1.23 (model 2). Nevertheless, the coronary angiographic classification retained its statistical significance as a predictor of survival on univariate analysis ($p < 0.001$) and in each proportional hazards model (model 1, $p = 0.014$; model 2, $p = 0.042$). In summary, the recalculated survival rate of patients who had preliminary CABG still was surpassed only by patients who were found to have either normal coronary arteries or mild to moderate CAD by coronary angiography.

Cardiac events. Insofar as we can determine, the 5-year incidence of cardiac events (defined as fatal MI, late CABG, or PTCA) was 12% for the series (men, 12%; women, 14%; $p = 0.37$) and could be correlated only with the coronary angiographic classification ($p = 0.005$). Cardiac events were documented in 4% of patients with mild to moderate CAD, in 15% of those with advanced but compensated CAD, and in 19% of those for whom coronary angiography was not performed. In comparison, severe CAD was associated with 5-year cardiac event rates of 10% after CABG, 13% after PTCA, and 31% when it was inoperable.

We made no attempt to calculate the incidence of late nonfatal MI because its diagnostic criteria were difficult to establish on the basis of a telephone canvass. Even our estimates of fatal MIs may be understated in this respect, especially in patients who did not undergo preliminary coronary intervention preceding their AAA procedures. Although 50 of the 97 late deaths in this series were clearly related to cardiac complications (MI, arrhythmias, congestive heart failure), the cause of death in another 30 patients was unknown. Many of these deaths occurred suddenly and may also represent cardiac events.

DISCUSSION

Our results are concordant in many respects with those that have been reported by the Canadian Society for Vascular Surgery.[15] Both investigations indicate that gender does not influence either the early risk or the late outcome of surgical treatment for intact AAAs, and each study strongly suggests that late survival rates for all patients are primarily related to age, the serum creatinine level, and the presence of CAD at the time of operation. Since age and serum creatinine largely represent irremedial risks, severe CAD is the single factor that may be favorably modified by either medical management or therapeutic intervention in selected patients. In addition to our own work in this regard, experience elsewhere has also shown that patients who undergo CABG before AAA repair have lower operative mortality rates and higher long-term survival rates than patients with CAD of unknown severity.[23-25] While PTCA may prove to be as beneficial as CABG among candidates who are suitable for either type of treatment, only scant data

Table V. Estimated survival rates according to age, creatinine, and coronary angiographic classification by Cox proportional hazards model

		Estimated survival rates			
		Age ≤70		*Age >70*	
Angiographic classification	*Serum creatinine (mg/dl)*	*3 yrs*	*5 yrs*	*3 yrs*	*5 yrs*
Patients without angiograms	<1.5	89	85	73	64
	1.5-2.5	86	80	67	56
	>2.5	64	52	30	17
Normal coronary arteries or mild to moderate CAD	<1.5	93	90	83	76
	1.5-2.5	91	88	78	70
	>2.5	76	67	48	34
Advanced but compensated CAD	<1.5	90	85	75	65
	1.5-2.5	87	81	68	57
	>2.5	65	54	32	19
Severe correctable CAD with CABG	<1.5	93	90	83	76
	1.5-2.5	92	88	79	70
	>2.5	77	68	49	35
Severe unoperated CAD					
With PTCA	<1.5	91	87	77	68
	1.5-2.5	88	83	71	61
	>2.5	68	58	36	22
Inoperable	<1.5	72	61	41	27
	1.5-2.5	65	53	31	18
	>2.5	27	15	3	1

previously have been available concerning the outcome of PTCA in patients with AAAs.[26]

Taylor et al.[27] have expressed reservations about the use of preoperative cardiac screening in patients who are scheduled for elective vascular surgery on the basis that only eight (2.8%) of the 285 elective procedures in the year of their particular study were complicated by perioperative MIs, none of which were fatal. No information concerning late survival was provided in this report, however, and its conclusion that preoperative cardiac assessment should be reserved only for patients who have unstable angina, uncontrolled arrhythmias, or congestive heart failure seems unnecessarily restrictive even in the limited context of early results. An impressive volume of literature has confirmed that CAD is prevalent among patients who require vascular surgery and that it profoundly influences their perioperative risk and life expectancy.[28,29] Several prospective, randomized trials and countless case series have demonstrated that CABG significantly enhances the survival rate of patients who are selected for intervention on the basis of many factors that are beyond the scope of this discussion, including coronary anatomy (number and distribution of diseased vessels), left ventricular function, provocable ischemia on noninvasive testing, and in some cases, age and gender.[30] The operative mortality rate of CABG has historically been slightly higher in patients ≥65 years old and in women, but the late survival rates for these groups either match or surpass the comparable figures for younger patients and for men.[31-38]

A great deal of interest has been devoted to noninvasive cardiac assessment before elective vascular surgery since Boucher et al.[39] described dipyridamole-thallium myocardial imaging for this purpose in 1985. Eagle et al.[21] and Baron et al.[40] subsequently demonstrated that noninvasive screening yields the most useful and cost-effective information when it is obtained selectively in patients who are likely to have CAD on the basis of their age, their cardiac history, and the results of a standard ECG. By using such selective criteria, Cambria et al.[41] and Suggs et al.[42] found that approximately 10% of the candidates for abdominal aortic reconstruction at their centers meet contemporary indications for preliminary coronary intervention. These modern data imply that the indications for CABG may have changed during the decade since we first reported our experience with preoperative coronary angiography, and indeed, they have. Many patients for whom CABG previously would have been recommended are now treated successfully by improved medical management or by PTCA, irrespective of

Table VI. Preliminary coronary intervention rates before surgical treatment of intact, infrarenal aortic aneurysms at the Cleveland Clinic

		Preliminary coronary intervention					
		CABG		*PTCA*		*Total*	
Series	*No.*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Current study (1983 to 1988)	582	111	19	29	5	140	24
Men	490	98	20	28	6	126	26
Women	92	13	14	1	1	14	15
Departmental registry (1989 to 1995)	650	64	10	44	7	108	17
Men	550	63	11	38	7	101	18
Women	100	1	1	6	6	7	7

whether they are under consideration for elective vascular surgery.

The frequency of coronary intervention before AAA repair for the 582 patients described in this report (1983 to 1988) is compared in Table VI to the intervention rates for the next 650 consecutive patients without a history of previous myocardial revascularization who received surgical treatment for intact AAAs from 1989 through August 1995 (unpublished departmental registry data). The preliminary intervention rate has declined from 24% to 17% in all patients, from 26% to 18% in men, and from 15% to 7% in women. The incidence of preliminary PTCA has remained reasonably static during the past decade, and while it recently has been slightly higher among women, the number of women in each group is too small to establish a definitie trend in this regard. Perhaps more importantly, our overall use of preliminary CABG appears to have declined approximately by half throughout the second period of study. This finding is consistent with the fact that the indications for CABG have undergone further refinement during the past several years, and it also reflects our growing reliance upon functional, noninvasive cardiac assessment in selecting patients for preoperative coronary angiography. Unless angiography is justified on the basis of active angina, we currently favor dobutamine stress echocardiography as a screening study because of its convenience, its relative economy, and its reported accuracy.[43-45]

Our data (Fig. 2) suggest that severe CAD will occasionally escape detection if noninvasive testing is obtained only in patients who have a positive history or ECG, but a compromise of this kind may be unavoidable. In the absence of such immediate risks as unstable angina, a recent MI, or profound left ventricular dysfunction, the benefit of preliminary coronary intervention is not adequately reflected by the perioperative complication rates associated with AAA repair even in patients who are suspected to have serious CAD. The benefit of CABG, in particular, has always been determined on the basis of long-term survival in the patients who receive it, and this is also the case in patients of either gender who are candidates for elective vascular surgery.

Becky Roberts maintained the database for this study, and Frances Federico assisted in preparing the manuscript.

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DISCUSSION

Dr. Marian F. McNamara (Zionsville, Ind.). Cardiovascular disease remains the number one cause of death in women and men. Gender differences have been defined over the last 10 years. Among these differences include a later onset of disease symptoms, a lower incidence of aneurysms, and a higher morbidity and mortality rate after coronary artery bypass surgery and myocardial infarction. Some authors have reported decreased long-term survival after infrainguinal bypass grafts and decreased patency of infrainguinal bypass grafts as well as an increased rate of restenosis after carotid endarterectomy. The population in this study is unique in that 80% of the patients had preoperative coronary angiography almost universally for severe symptomatic cardiac disease. Almost 25% of the patients had preoperative coronary artery bypass surgery. With this careful preoperative assessment and treatment, the cardiac complications of abdominal aortic aneurysm resection were few. The operative mortality rate, however, remained approximately 5%. The 5-year aggregate survival was 77% and similar for both genders. Johnston has reported a gender study of abdominal aortic aneurysm on the basis of the Canadian Vascular Registry involving multiple centers. The authors likewise found in this study no gender differences in operative mortality or in long-term survival. Coronary artery bypass surgery was infrequent in the Canadian series, and the 5-year cumulative survival was only 63.3%. Unfortunately, we do not know the severity of the coronary disease in this later series. Dr. Starr, you have increased our knowledge of the influence of gender on vascular disease. In addition, this study provides important information concerning coronary artery disease and specifically the risk of aneurysm resection on the basis of coronary anatomy and severity of disease.

I have several questions for the authors. What size criteria did you use to select patients for aneurysm resection? Were these the same for men and women? Was the operative mortality for preceding coronary artery bypass surgery the same for men and women at the Cleveland Clinic? Lastly, you identified 15 patients with severe coronary artery disease whose coronary lesions were inoperable. Could you review for us the operative mortality rate and long-term survival in this group?

Dr. Jean Starr. The size criteria that was used was not directly recorded; however, it is our general policy at the Cleveland Clinic that men in general tend to be operated on at around 5 cm. In women, however, because they tend to have smaller vessels, the criteria are not quite as strict, and there has been a trend to begin repairing them at a smaller size. A smaller AAA in a woman may represent the same risk for rupture as a somewhat larger AAA in men.

Regarding your second question on the mortality after coronary artery bypass grafting, Dr. Loop published a series in 1983 that examined approximately 2400 consecutive women and approximately 1900 men. The operative mortality rate for women was 2.9% and 1.3% for men. This difference was found to be statistically significant. However, when they applied Cox proportional hazards model, it was found that body surface area and not sex influenced mortality and that patients of either gender with smaller body surface area tend to have smaller coronary size.

In response to your third question, what indeed happened to the patients after aneurysm repair, who were found to be inoperable for their coronary artery disease? Three of the 15 patients died after aneurysm repair, for a mortality rate of 20%. To compare, those who underwent PTCA had no operative mortality after aneurysm repair, and those who had undergone preliminary coronary artery bypass grafting had approximately 5% mortality rate after aneurysm repair.